Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (canceled)

2. (previously presented) The method of claim 8, wherein said characteristic function further comprises information concerning an environment in which sound is to be perceived.

3. (previously presented) The method of claim 8, wherein said characteristic function is a spatial feature extraction and regularization model.

4. (original) The method of claim 3 wherein said spatial feature extraction and regularization model comprises a spatial component and a temporal component.

5. (original) The method of claim 4 wherein said temporal component comprises a summed matrix of a predetermined number of eigen vectors.

6. (original) The method of claim 5 wherein said predetermined number of eigen vectors is of a range from 3 to 16.

7. (original) The method of claim 5 wherein said spatial and temporal components are determined via a Karhunen-Loeve Expansion.

8. (previously presented) A method of reducing the amount of computations required to create a sound signal representing one or more sounds originating at a plurality of discrete positions in space, where the signal is to be perceived as simulating one or more sounds at one or more selected positions in space with respect to a listener, comprising the steps of:

determining a spatial characteristic function for a position in space at which sound originating at a plurality of positions in space is to be received, wherein said characteristic function represents a head-related impulse response;

applying said characteristic function as a filter to said signal representing sound to produce a filtered signal; and

converting said filtered signal to a sound wave and producing said sound wave for a listener;

wherein said spatial characteristic function is determined for a selected number of N samples and a selected number of M eigen values and wherein said model filter function for an azimuth position θ and an elevation position φ of sound originating in a spherical coordinate system about said position of sound measurement as said origin has a form

$$y(n) \;=\; \sum_{m=1}^{M}\left[\sum_{k=1}^{K} w_m(\theta_k,\varphi_k)s_k(n)\right]q_m(n) \quad 9(c)$$

where s represents a sound source, K represents a number of independent sound sources, $w_m(\theta,\varphi)$ are weighting factors, and $q_m(n)$ is a vector representing an orthonormal basis for a head-related impulse function.

9. (currently amended) Apparatus for providing sound created by a sound source to a listener which simulates the sound source at a selected position in space with respect to the listener, comprising:

an input for receiving a signal representing sound originating at a plurality of positions in space, said input being adapted to receive a plurality of positions, said plurality of positions comprising any one of including multiple sources without reflections, and multiple sources each with reflections;

a left channel and a right channel, wherein each channel comprises a filter array for applying a filter to said signal received by said input to provide a filtered signal, said filter comprising a linear function including a spatial component which comprises a head-related impulse response; and

an output for converting said filtered signals from said channels to a binaural sound and for producing said sound for a listener;

wherein said linear function comprises a spatial feature extraction and regularization model.

10. (canceled)

11. (original) The apparatus of claim 9 wherein said linear function includes a spatial component, said spatial component comprising signal delay and attenuation for simulating reflected sound created by surfaces of a sound reproduction environment.

12. (currently amended) Apparatus for providing sound created by a sound source to a listener which simulates the sound source at a selected position in space with respect to the listener, comprising:

an input for receiving a signal representing sound originating at a plurality of positions in space, said <u>input being adapted to receive a</u> plurality of positions<u>, said plurality of positions comprising any one of</u> ~~including~~ multiple sources without reflections, and multiple sources each with reflections;

a left channel and a right channel, wherein each channel comprises a filter array for applying a filter to said signal received by said input to provide a filtered signal, said filter comprising a linear function including a spatial component which comprises a head-related impulse response; and

an output for converting said filtered signals from said channels to a binaural sound and for producing said sound for a listener;

wherein said linear function includes a temporal component, said temporal component comprising a summed array of a predetermined number of eigen filters.

13. (currently amended) Apparatus for providing sound created by a sound source to a listener which simulates the sound source at a selected position in space with respect to the listener, comprising:

an input for receiving a signal representing sound originating at a plurality of positions in space, said input being adapted to receive a plurality of positions, said plurality of positions comprising any one of ~~including~~ multiple sources without reflections, and multiple sources each with reflections;

a left channel and a right channel, wherein each channel comprises a filter array for applying a filter to said signal received by said input to provide a filtered signal, said filter comprising a linear function including a spatial component which comprises a head-related impulse response;

an output for converting said filtered signals from said channels to a binaural sound and for producing said sound for a listener;

an environment input for receiving information concerning a listening environment to be simulated and relative position of a listener; and

a calculator for receiving said information from said environment input, and calculating attenuation and time delays to simulate said environment and said listener position;

wherein said output of said calculator is input into said filter array as factors for said linear function.

14. (original) The apparatus of claim 13 further comprising a summed array of a predetermined number of eigen filters attached to said signal input and receiving the signal therefrom, wherein said eigen filters introduce time delays into said signal.

15. (currently amended) Apparatus for providing sound created by a sound source to a listener which simulates the sound source at a selected position in space with respect to the listener, comprising:

an input for receiving a signal representing sound originating at a plurality of positions in space, said input being adapted to receive a plurality of positions, said plurality of positions comprising any one of including multiple sources without reflections, and multiple sources each with reflections;

a left channel and a right channel, wherein each channel comprises a filter array for applying a filter to said signal received by said input to provide a filtered signal, said filter comprising a linear function including a spatial component which comprises a head-related impulse response;

an output for converting said filtered signals from said channels to a binaural sound and for producing said sound for a listener;

an environment input for receiving information concerning a listening environment to be simulated and relative position of a listener;

a calculator for receiving said information from said environment input, and calculating attenuation and time delays to simulate said environment and said listener position, with an output of said calculator is input into said filter array as factors for said linear function;

a summed array of a predetermined number of eigen filters attached to said signal input and receiving said signal therefrom, wherein said eigen filters introduce time delays into said signal;

a plurality of source placement arrays, wherein each source placement array receives said output of a single eigen filter and filters said signal in accordance with a spatial characteristic function and said output of said calculator;

a summer for summing said output of said source placement arrays; and

a timer and delay for receiving said summed output signal from said summer and a delay count from said calculator.

16. (canceled)

17. (canceled)

18. (canceled)

19. (canceled)

20. (canceled)

21. (currently amended) An apparatus for efficiently simultaneously processing a simulation of a plurality of sound signals in a three dimensional space, each channel within said apparatus comprising:

at least one delayer for delaying a sound source signal;

at least one attenuator for attenuating said delayed a sound source signal;

a plurality of filters for filtering said attenuated sound signal;

a plurality of weighting elements to weight said filtered sound signals; and

a summer for summing said filtered sound signals;

wherein said plurality of filters remain constant, with at least one of said at least one delay element, said at least one attenuator, and said plurality of weighting elements adapted to change a perceptive position of said sound source signal to a listener; and

wherein said sound source signal received by said at least one delayer comprises any one of plurality of sound signals comprise multiple sources without reflections, and multiple sources each with reflections.

22. (canceled)

23. (currently amended) A method for efficiently simultaneously processing a simulation of a plurality of sound signals in a three dimensional space, each channel within said apparatus comprising:

delaying a sound source signal;

attenuating <u>said delayed</u> a sound source signal;

filtering said attenuated sound signal to form filtered sound signals;

weighting said filtered sound signals to form weighted, filtered sound signals; and

summing said weighted, filtered sound signals;

wherein said filtered attenuated sound signal remains constant, with at least one of said delayed sound source signal, said attenuated sound source signal, and said weighted filtered sound signals are adapted to change a perceptive position of said sound source signal to a listener; and

wherein said <u>sound source signal received by said at least one delayer comprises any one of</u> ~~plurality of sound signals comprise~~ multiple sources without reflections, and multiple sources each with reflections.

24. (canceled)

25. (currently amended) An apparatus for efficiently simultaneously processing a simulation of a plurality of sound signals in a three dimensional space, each channel within said apparatus comprising:

means for delaying a sound source signal;

means for attenuating said delayed ~~a~~ sound source signal;

means for filtering said attenuated sound signal to form filtered sound signals;

means for weighting said filtered sound signals to form weighted, filtered sound signals; and

means for summing said weighted,filtered sound signals;

wherein said means for filtering said attenuated sound signal remains constant, with at least one of said means for delaying said sound source signal, said means for attenuating said sound source signal, and said means for weighting said filtered sound signals are adaptive to change a perceptive position of said sound source signal to a listener; and

wherein said sound source signal received by said at least one delayer comprises any one of ~~plurality of sound signals comprise~~ multiple sources without reflections, and multiple sources each with reflections.

Claims 26 to 77 (canceled)

10